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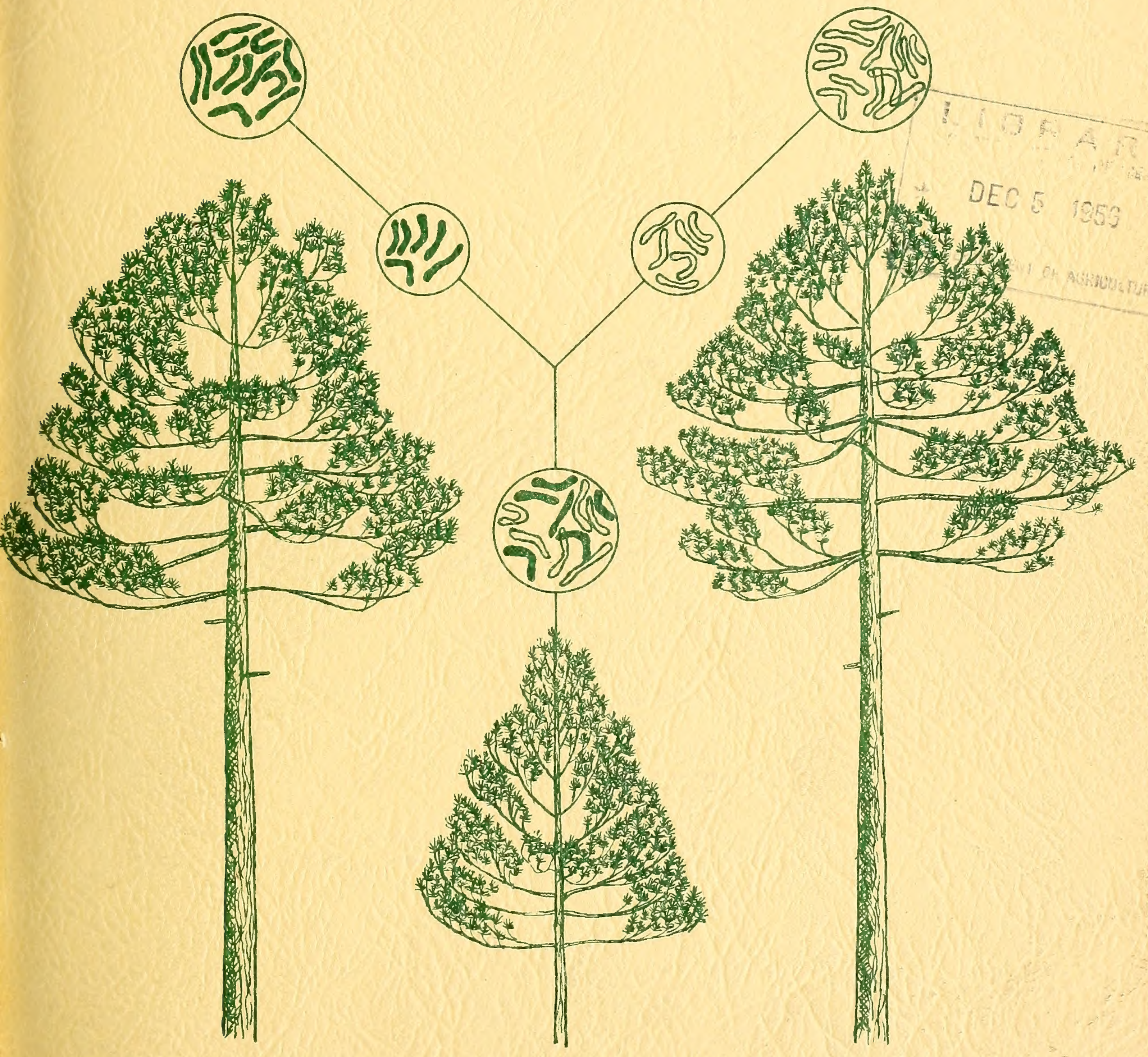
DE FOR SELECTING SUPERIOR FOREST TREES AND STANDS IN THE LAKE STATES

by Paul O. Rudolf



Lake States Forest Experiment Station
M. B. Dickerman, Director
U. S. Department of Agriculture - Forest Service

FOREWORD

This "Guide for Selecting Superior Forest Trees and Stands in the Lake States" has been developed under the sponsorship of the Lake States Forest Tree Improvement Committee. The Committee was created in 1953 to encourage and coordinate forest tree improvement activities in the Lake States.

Since that time two forest tree improvement conferences have been held (1953 and 1955), the proceedings for which were published by the Lake States Forest Experiment Station. The present guide should be a valuable additional contribution to the advancement of forest genetics in the Lake States.

Earl J. Adams, Chairman	M. B. Dickerman, Director
Lake States Forest Tree	Lake States
Improvement Committee	Forest Experiment Station

GUIDE FOR SELECTING SUPERIOR FOREST TREES AND STANDS IN THE LAKE STATES

Prepared by
Paul O. Rudolf*

Station Paper No. 40 September 1956

Lake States Forest Experiment Station**
Forest Service, U. S. Department of Agriculture

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**Maintained at St. Paul 1, Minn., in cooperation with the University of Minnesota.

PREFACE

One of the first activities initiated by the Lake States Forest Tree Improvement Committee after its establishment in 1953 was to assemble information basic to the selection of superior trees and stands. The present text, together with numerous illustrations, constitutes that portion of the material most useful as a guide for fieldmen.

All those who have participated in the preparation of this guide are aware of its deficiencies. They realize that better information on the heritability of many traits, the more precise detection of these traits in the field, and better illustrations would have made a much improved guide possible. They were agreed, however, that it was better to proceed now with the best information at hand than to wait many years for the better quality ingredients desired.

To be most effective, the use of this guide by fieldmen should be preceded by training meetings at which tree improvement specialists can point out on trees and stands what features are desirable in selection. Trees especially desirable silviculturally usually will also be desirable for tree improvement purposes. Such meetings can be arranged through the Tree Improvement Committee.

In the course of its preparation this guide was reviewed thoroughly by all members of the Tree Improvement Committee and a number of persons outside the Committee. Acknowledgment is due for the help of all those reviewers and especially the latter group, which includes the following: C. C. Heimburger of the Ontario Department of Lands and Forests; J. W. Duffield of the Forest Industries Tree Nursery at Nisqually, Washington; Leo Isaac of the Pacific Northwest Forest and Range Experiment Station; and several staff members of the Lake States Forest Experiment Station. Special acknowledgment also is due T. L. Mielke of the Forestry Division, Minnesota Conservation Department, for designing the cover and drawing the figures on pages 8, 9, 10, and 13.

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GUIDE FOR

SELECTING SUPERIOR FOREST TREES AND STANDS IN THE LAKE STATES

A SUGGESTED PROGRAM

To improve our Lake States timber and pulpwood stands genetically we must select, protect, and utilize our superior trees and stands. Immediate steps can be taken by applying forest tree improvement principles in marking stands for cutting and in collecting seed for reforestation. The following procedure is suggested.

1. Select superior stands of as many species as possible. Rogue out poorer individuals and thin to favor the best trees and to improve their seed production. Use these stands as far as possible to supply seed for reforestation purposes. Make certain that progeny are available before the stands are cut.

2. For all merchantable species throughout the region, select trees of superior growth, form, quality, and resistance to damage. Get the cooperation of all foresters--federal, state, and private--in locating and recording such trees. Arrange to have the trees prominently and distinctively marked so they will not be cut indiscriminately. Tree breeders should examine outstanding trees as soon as possible.

3. Foster practices which will favor these superior trees so that they will provide as high a proportion as possible of the natural regeneration in their stands. Use these trees so far as possible to provide seed for local reforestation.

4. Make these trees, especially the most outstanding (plus trees), available for tree breeding purposes. If they must be destroyed, try to establish seed plantations from them first. As a safety measure to preserve the germ plasm, propagate cuttings or grafts of the best trees.

5. Wherever possible, build up breeding collections of good types of our indigenous species from areas over their entire natural range. These could serve as living herbaria to provide seed, scions, and pollen. They would also provide rough indicator provenience tests.

6. Encourage more research in forest tree improvement.

WHY SELECT SUPERIOR TREES AND STANDS

The need for improving our forest stands is becoming more generally recognized. Our original forests were made up largely of old-growth virgin stands, which had developed over centuries in place. Presumably such stands were well adapted to their localities. However, cutting has removed most of the virgin forests, and even in the remaining old-growth stands there has been a certain amount of high-grading. Consequently, many of the trees that now make up our stands probably are inherently poorer than those in the best virgin stands. By selecting and reproducing the best of the trees still available, however, we can bring the quality of our growing stock up to its former level. Furthermore, the use of these superior trees in breeding programs can improve the stock even more.

In the Lake States we need to plant or seed several million acres of forest land if they are to be satisfactorily stocked with desirable forest trees. Additional millions of acres bear relatively low-quality stands. Such areas should be restocked with trees at least equal to the best of our original stands in growth, form, and adaptability to local conditions. Furthermore, the growing demands of an increasing population will make it an urgent necessity in the future not only to bring all forest land up to full stocking, but also to obtain the maximum yield of fully stocked stands. We can meet the latter objective only by tree improvement.

Often there is tremendous variation among individual trees of the same species and age, even in small stands. Some of this variation doubtless expresses environmental factors or treatment which the stands have received. However, some of it also reflects primarily hereditary characteristics of the individual trees. Therefore, a first step in growing improved forests involves the recognition and selection of superior trees.[1/] Such trees can be used as a source of seed for artificial regeneration, favored in cuttings so their progeny will make up a larger part of the natural reproduction, and used in tree breeding. It must be emphasized, however, that the selection of phenotypically superior trees is only an initial step in the ultimate objective of isolating genetically desirable gene combinations.

1/ Trees that are judged to be superior from external appearances only are called phenotypically superior. Our first selection must be made upon these bases. Trees that transmit their superior characteristics to their progeny are called genotypically superior. Such trees are the ultimate goal of selection.

We must recognize, too, that it is advisable to isolate aberrant and wholly undesirable phenotypes. Progeny testing of such individuals theoretically is quite as important as the testing of desirable types. In other words, we want to know whether the bad as well as the good qualities are inherited.

For the present, we must assume that locally developed stands are best for the local conditions. We must also be aware, however, that trees of other origins may be better than those native to individual localities. This has already proved true for some races of Scotch pine in Europe and appears to be the case for Douglas-fir on the West Coast and red pine in New York. Until thorough research, based on progeny tests, brings to light such superior races, however, it is best to use the finest local stands as a basis for forest tree improvement. Such stands should contain a high proportion of superior trees.

WHAT TO LOOK FOR

Forest stands usually contain about as many trees above as below average in size, form, resistance to damage, and other desirable characteristics. In tree improvement it is the above-average trees which are of prime interest. Many of these trees are only a little above average, some are distinctly better, and a few may be outstanding. The latter two classes hold the greatest promise for tree improvement.

In this report we refer to the distinctly better trees as "superior trees" and those that are outstanding as "plus trees." Foresters should favor both classes in intermediate cuttings so that such trees will make up the highest possible proportion of the final stand and contribute as much as possible to natural regeneration. They should also favor them in seed collection activities. The plus trees, in particular, should be fully utilized in tree breeding. No plus tree should be cut until it has been propagated to preserve the germ plasm. Such plus trees as progeny tests prove to be genetically superior are called "elite trees."

As a rule, superior and plus trees must be selected in places where they can be compared with others of the same species and age that developed under the same site conditions. Normally, it is impossible to compare isolated trees directly with others similar in age, species, and growing condition. Nevertheless, any isolated, open-grown trees should be selected if they have superior growth form indicating inherent straightness of stem, fine branches, and good self-pruning in an environment that is not conducive to the best expression of these characteristics. Such trees, as well as superior

phenotypes in closed stands, and also trees showing unusual resistance to diseases, insects, or other enemies, can provide valuable material for tree improvement.

Plantations, if old enough, offer especially good opportunities for selecting superior trees because all individuals are of one age and species (usually) and site differences generally can be identified. Furthermore, plantation trees have already undergone considerable selection in the nursery and planting processes. They may, therefore, be more suitable as a seed source for reforestation purposes than original or "wild" material.

Ordinarily, trees should be of harvesting age or size before they are considered for superior or plus tree designations. This is particularly true of plantations of exotic species or of trees of unknown or nonlocal seed origin.

Younger trees may be selected if they show marked resistance to certain diseases or insects or if they show special value for Christmas tree production or nurse-crop use. As a rule, however, no trees less than 20 years old should be chosen.

At present we know comparatively little about the genetic constitution of trees, and there is some uncertainty in attempting to rate trees for inherent superiority on the basis of visible characteristics. Some trees that look good actually may be poorer genetically than others that outwardly appear less desirable. Only through progeny tests can the genetic worth of any tree be ascertained. However, a possible shortcut for evaluating inherent superior growth form and individual growth rate may be the so-called "tree shows" used by Syrach Larsen in Denmark. They consist of grafts of phenotypically superior individuals which are set out at wide spacings in appropriate test areas.

Before either kind of evaluation test is made, though, the first step is to select phenotypically superior trees. Some of them undoubtedly will prove to be superior genetically.

TRAITS OF IMPORTANCE IN ALL SPECIES

All tree characteristics are governed to some extent by heredity. Some characteristics are strongly modified by environment, whereas others are modified much less. Actually, so little is known of the reaction range in tree genotypes that it is practically impossible to classify characteristics as strongly or loosely controlled by heredity. Following, however, are some tree characteristics more or less readily determined from external appearances and generally believed to reflect heredity strongly. They are listed in 4 groups, the first 3 of which are concerned chiefly with wood production.

Traits easily observed or measured at any season of the year (growth rate, branching habit, and stem form).

Traits generally evident only at certain times or seasons (resistance to climatic factors, diseases, insects, and animals).

Traits distinguishable only by special tests, or not readily discernible (wood quality, relative tolerance, and photoperiodic response).

Traits not directly concerned with wood production (seed production and volume and quality of special products).

Often it is difficult to evaluate these traits. Some suggestions are given, but better bases will have to be worked out. However, it is important to start now, using the best knowledge we have, rather than to wait for better means of measurement.

TRAITS EASILY OBSERVED OR MEASURED AT ANY SEASON

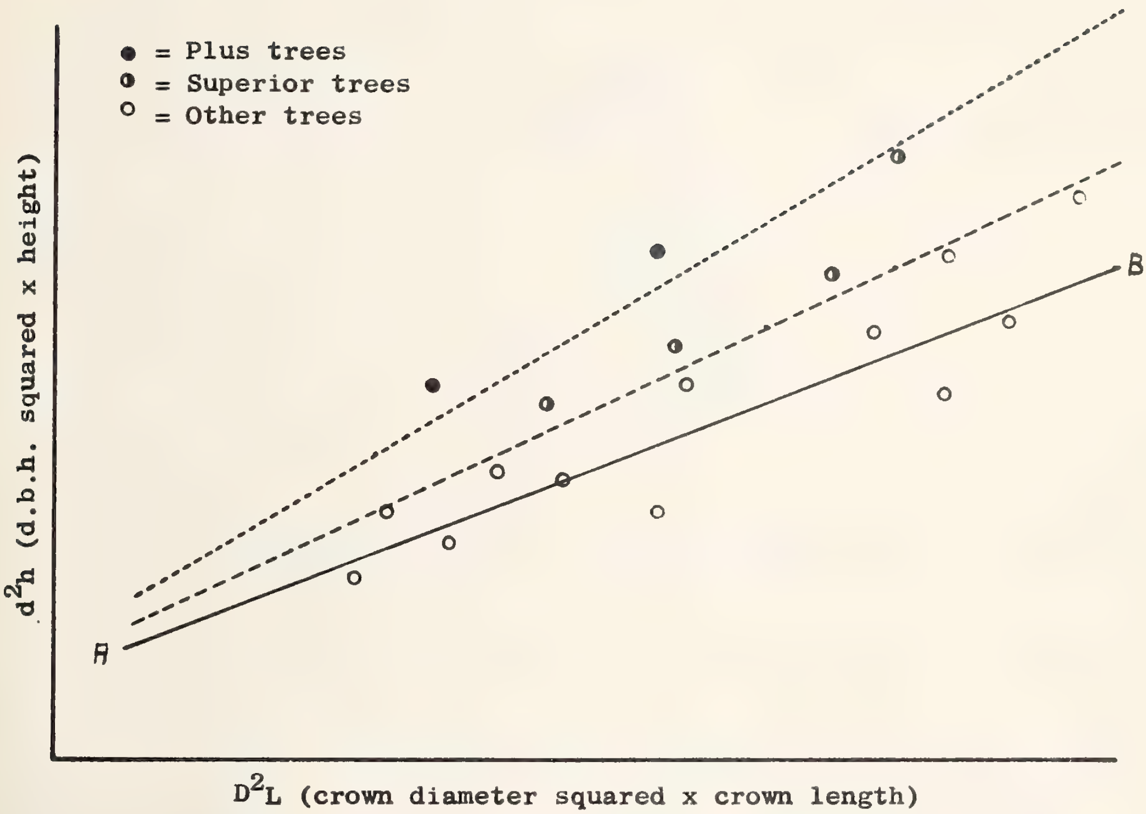
Growth Rate

Growth rate by itself probably has been somewhat overemphasized as a desirable and heritable characteristic of forest trees. But, combined with suitable wood quality and resistance to injury, it must be considered as one of the major characteristics with possibilities for use in tree improvement. Superiority in growth rate can best be judged by comparison of trees in the same age group growing together. Use of a percentage relationship (see next page) largely eliminates soil and other site differences as variables of potential importance, and is applicable with most species.[2/] However, species commonly arising from root sprouts, aspen for example, cannot be compared with confidence in this way.

Superior trees selected for breeding should have a vigor ratio (next page) at least 20 percent, and plus trees a ratio at least 50 percent greater than the average for the trees within one chain (66 feet) that are of comparable age and species and growing under similar conditions.

For plantations or for sawtimber trees (10 inches or more in d.b.h.), a vigor ratio of 1.10 may be sufficient to indicate superior trees and 1.25 to indicate plus trees.

2/ Selection in relatively young stands (or from early indications of progeny tests) will favor the "sprinters," those trees with rapid juvenile growth and early culmination of growth. Wolf trees usually are of this type. Selection in mature stands, on the other hand, will favor "stayers," those trees capable of sustained growth in dense stands and attaining relatively large dimensions. Over the rotation, such trees produce more cellulose per acre per year than the sprinters. The ideal improved stand probably should contain a mixture of "sprinters," "stayers," and trees of intermediate character of the same species in proportions not yet determined.

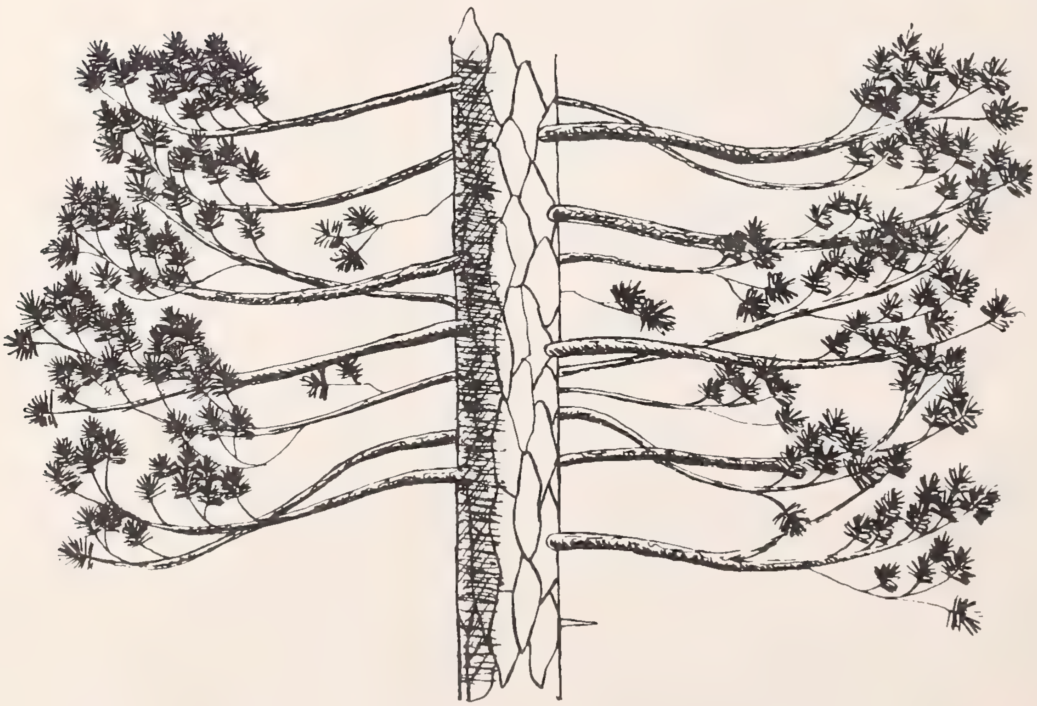


Vigor ratios for selecting superior and plus trees. The trend AB is that of the general run of trees as affected by suppression, competition, or stocking. If the site is the same, then being above the trend by a certain amount (dotted lines) would indicate special vigor. The trend AB will probably vary from stand to stand.

Crown Development

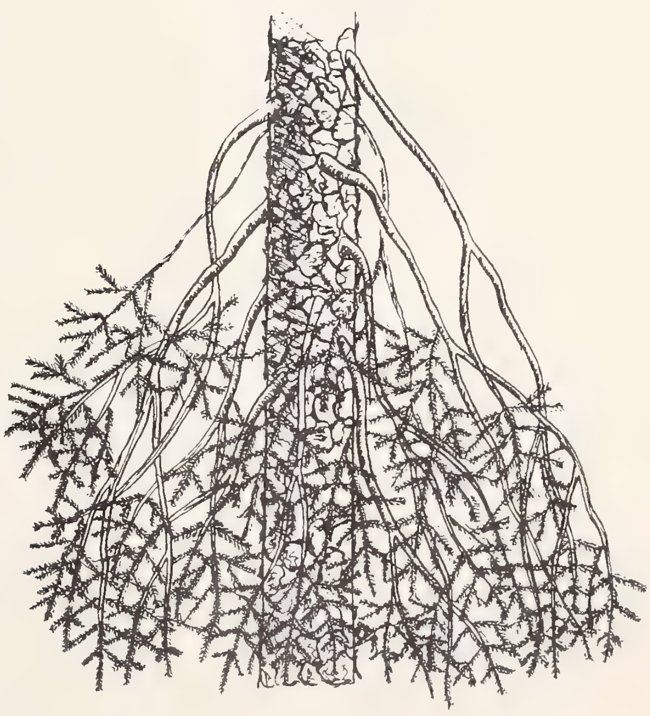
For timber and pulpwood production, selected trees, when compared with the average, should have branches that are short, of small diameters, and, at least in sawtimber, at an angle as close as possible to 90° with the axis of the main stem. Top thrift and shedding of lower branches are important. These characteristics commonly are associated with tolerance (page 13). Other characteristics may make trees superior for other purposes.

Desirable trees have branches that are short, of small diameter, and at an angle of 90° with the axis of the main stem.



Branches that
are thick or
sweep up from
the axis of the
main stem are
undesirable.

Branches that droop
from the main stem
also are undesirable.



Stem Form

Seek trees that have a straight bole with a minimum of taper. Forking ordinarily is undesirable.

Trees with rapid taper in the main stem, thick branches, and wide, spreading crowns are undesirable.

Bent or crooked main stems are undesirable features.

TRAITS DISCERNIBLE ONLY AT CERTAIN TIMES

Resistance to Temperature, Moisture, and Other Climatic Extremes

Selected trees should be able to withstand local temperature changes regardless of season. Normally, seed sources collected locally produce trees that are particularly resistant to adverse local climatic conditions. However, when tree species are introduced to a new locality or planted outside their natural ranges, the ability to withstand local climatic extremes becomes of special importance. Look for trees that tolerate extremes of drought or wetness to provide plants suitable for regenerating unusually dry or wet sites. Seek also trees that exhibit marked resistance to damage from heavy winds, sleet or glaze storms, or heavy snows for reproducing in areas where such climatic dangers are to be expected.

Disease and Insect Resistance

Preferably, superior trees should be free, or nearly so, of damage from insects or diseases. In stands that are heavily attacked by some insect or disease, select trees that show complete or considerable freedom from attack. So far, more instances of disease resistance than insect resistance have been reported for forest trees. It may not be possible, therefore, to find individual trees resistant to both kinds of pests.

Resistance to Animal Damage

Superior trees should be free of serious damage from mammals or birds. In stands where such injury is common, select trees that display little or no damage or excellent recovery from damage.

TRAITS NOT READILY DISCERNIBLE

Wood Quality

Since quality requirements vary for veneer, sawtimber, pulpwood, and other products, it is not likely that trees can be selected that will be superior for all products. However, it still is desirable to select those that produce wood better than average for any one product, recognizing that this may not be a simple matter. For instance, pines that have 50 percent or more summerwood per annual ring probably will produce more pounds of pulp per cord of wood than those with less summerwood. The proportion of summerwood or springwood also has rather specific qualitative effects. These may be favorable or unfavorable depending upon the product to be made. Thus high summerwood percentage may increase tearing strength of paper, but diminish bursting and folding strength; exactly opposite effects have been indicated for wood high in springwood content. Other wood quality factors, including the composition and specific location in the cell wall of certain chemical components, and variations in fiber dimensions, are also known to affect results in pulping and papermaking, and must therefore be taken into account.

For sawtimber and veneer production, straightness of grain is important, and compression wood is undesirable. Certain special characteristics among hardwoods are needed for some products. These include toughness and resilience in hickory, bird's-eye in maple, curly grain in walnut or birch, and other similar variations.

Trees with superior characteristics in wood quality usually cannot be detected from external appearance. Hence locating such trees is a job for specialists. However, trees of this kind may occasionally be found in the course of other work--for example, when taking increment cores for survey work. When this occurs, the tree should be reported.

Photoperiod

Variation in photoperiod is difficult to recognize in stands, but it may be sufficiently distinct in nursery beds to be recognized. Individual trees may, for instance, show early or late terminal growth substantially different from similar trees of the same species. Within our region this factor may not be of critical importance, but it must be considered in using exotic species such as Norway spruce, Scotch pine, and others from northern Europe, or native species of wide latitudinal range such as aspen, cottonwood, jack pine, or white spruce. For Douglas-fir in the Pacific Northwest, most rapid growth is associated with early bud-bursting,

although this may not be true for the species in other parts of its range. We should make observations, however, to see if this association may not hold true for some Lake States species also.

Relative Tolerance

Although tolerance is difficult to evaluate, trees undergoing competition that normally would have harmful effects frequently show better-than-average ability to remain thrifty. Such trees should be selected. The "stayer" type of trees (showing sustained growth over a long period) commonly is more tolerant of shade and competition, and a better producer of wood in the long run, than are the "sprinter" (rapid juvenile growth) or intermediate types.

Trees that remain reasonably thrifty
despite overtopping are desirable.

TRAITS NOT DIRECTLY CONCERNED WITH WOOD PRODUCTION

Seed Production

Most trees do not produce both wood and seed in abundance at the same time. Because we are primarily interested in wood production, do not select a tree as superior on the basis of seed production alone. It is the scrubby, bushy tree that usually produces the most seed. The "sprinter" normally is a much better seed producer than the "stayer."

Nevertheless, among the best formed and best wood-producing trees some will be better seed producers than others. These better seed producers should be favored in selecting superior trees for wood production. Furthermore, the seed-producing capacity of superior trees can be improved greatly by judicious thinning. Selected trees should be given additional space for crown and flower development for some time before rating them as to seed production.

Volume and Quality of Products Other Than Wood

Select trees that produce products other than wood, such as fruits, nuts, oil, tannin, sugar, or oleoresin, on the basis of better-than-average production. As a general rule, consider superior those trees that produce at least twice as much as the average. Look for quality as well as quantity. Unusual size of the edible portion of fruits and nuts (and thin shells) is as important as large volume production.

TRAITS OF IMPORTANCE IN PARTICULAR SPECIES

In addition to the hereditary traits described in the preceding list, there are special traits to look for in individual species. Some of these are listed on the following pages.

RED PINE (PINUS RESINOSA)

Superior red pines should have better-than-average branching habit. Especially desirable are those with thin and limber branches that will not break off at the main stem or pull out when loaded with heavy snow. In the southern parts of the Lake States, search for planted trees that show little or no damage from the European pine shoot moth. This insect may be a limiting factor in growing red pine in that area on sites otherwise suitable. Hunt also for trees apparently resistant to the Saratoga spittlebug and the red-headed pine sawfly.

The mature red pines in the center foreground represent such desirable features as straight stem, good natural pruning, moderate crown width, and reasonably thin branches at an angle near 90° to the axis of the main stem.

This mature red pine has a straight stem and fairly good natural pruning, but the crown is broad, the branches are rather heavy, and most of them come out of the stem at an undesirable angle.

An open-grown young red pine of an undesirable type. It has a wide crown and thick branches with little natural pruning. The branch angle, however, is near 90°--a desirable feature.

The forked stem and rather heavy branches make this red pine undesirable.

This red pine is undesirable because of its unusually poor stem form.

EASTERN WHITE PINE (<u>PINUS STROBUS</u>)

Superior white pines should be resistant to blister rust. Preferably, the trees should be free of rust cankers and be growing in highly infected unprotected stands in which infection is at least 20 years old. Seek white pines that have escaped the white-pine weevil. Look also for trees with inherently slender leaders because such leaders are less susceptible to attack than thicker leaders. White pine prunes itself very poorly, but seek trees above average in that respect.

There is a strong likelihood that this species may include races especially adapted to growing on limy soils, acid soils, swamps, and other special conditions. Canadian experience indicates that northern strains planted farther south grow slower than southern strains, compete less effectively with weed growth in plantations, and show rather high mortality in nurseries. On the other hand, southern strains moved to the north show severe weevil damage and winter browning of foliage.

A generally desirable old-growth white pine. The stem is straight, natural pruning is fairly good, the crown is of moderate width, and the branch angle is close to 90°. The branches are a little thicker than desirable, however.

An undesirable white pine. The stem is straight, but the branches are long and thick and sweep up at an undesirable angle.

A mature white pine with unusually short branches, a desirable feature. (Photo courtesy University of Wisconsin.)

An open-grown white pine of desirable form. For the conditions in which it is growing, neither crown breadth nor branch thickness are excessive. Branch angle is good, and the stem is straight. Natural pruning is comparatively good.

JACK PINE (*PINUS BANKSIANA*)

Select trees that have been exposed to and escaped attack by insect pests such as the white-pine weevil, the jack-pine budworm, the jack pine shoot moth, the pine tortoise scale, pine sawflies, and diseases such as the oak-pine gall rust. Look for trees with non-serotinous cones in areas where serotinous cones are the general rule and vice versa; a greater variety of silvicultural systems can be followed in managing this species if both cone types are available. For this reason, seek also trees with root systems that will favor greater windfirmness. Search also for trees that retain their vigor beyond the normal rotation age. Particularly desirable would be open-grown trees with good growth form and freedom from excessive branching. Look for trees free of serious porcupine damage in stands where porcupine girdling is common.

Of the two mature jack pines in the center foreground, the one at the left has shorter branches, better branch angle, a thriftier crown, and better natural pruning. It is the more desirable tree, although both have good form.

BALSAM FIR (*ABIES BALSAMEA*)

Find trees that escape budworm attack in infested stands, long-lived trees with no heart rot growing on sites where heart rot is prevalent, and trees late in leafing out as a protection against late spring frosts.

Rather typical open-grown balsam fir. The tree at the extreme right has the desirable feature of a somewhat narrower crown than the other two. All of them have reasonably good branch angle, reasonably thin branches, and little natural pruning. Trees of this type sometimes are called "double balsam" in the Christmas tree trade.

BLACK SPRUCE (*PICEA MARIANA*)

Select windfirm trees and those free of dwarf mistletoe in infected stands. In the northern part of its range, there appear to be both swamp and upland races. Assuming progeny tests will prove this, we should make selections accordingly of the right race or ecotype for given conditions.

WHITE SPRUCE (*PICEA GLAUCA*)

Search for trees of unusual windfirmness in this rather shallow-rooted species, and trees free of spruce galls in areas of general infestation. Look also for trees that are self-pruning to a high degree, are free from heart rot under old field conditions, occur in stands with a good expression of dominance, are free of tip weevils under conditions of severe infestation, leaf out late and thus escape spring frost damage, begin good height growth within 2 or 3 years after planting, escape serious injury from sawflies that occur epidemically in plantations, and are resistant to snow fungus in nurseries and young plantations.

A desirable mature white spruce. The stem is straight, the branches are reasonably short and not too thick, and natural pruning is good. An undesirable feature is the branch angle.

An undesirable white spruce. It has a very wide crown, thick branches, and a sharply tapering stem.

A narrow-crowned white spruce with short branches and good vigor. On the debit side the tree has drooping branches, some crooks in the stem, and poor natural pruning. (Photo courtesy Canada Department Northern Affairs and National Resources.)

A relatively even-aged stand of white spruce displaying at least four distinct crown types found in the species. Their relation to vigor and volume production has not yet been established for this species. (Photo courtesy Canada Department of Northern Affairs and National Resources.)

TAMARACK (LARIX LARICINA)

Resistance to the larch sawfly and the larch casebearer is a desired characteristic. The type of tree growing on drier sites may be more resistant to the sawfly than the regular swamp type. Resistance to late spring frosts, through late leafing-out, is desirable. Fast juvenile growth (the sprinter type) is desirable if tamarack is to be used as a nurse crop for other, more tolerant species on swamp sites. Because this species has given rather poor results in the nursery, select good trees in plantations as a source of seed. Search for trees free of porcupine damage in stands where such injury is prevalent.

A mature tamarack of good stem form, with fairly short, moderately thin branches coming out from the main stem at about 90°. Natural pruning has been fairly good. The tree has escaped serious injury from the larch sawfly.

SUGAR MAPLE (ACER SACCHARUM)

Trees that carry bird's-eye or other pleasingly figured wood are desirable. Aside from considerations of wood production, we should seek trees with sap of reasonably abundant flow and high sugar content. Selection for freedom from heart rot, mineral streak, and frost cracks in the northern part of its range also is important.

RED OAK (QUERCUS RUBRA)

We should select any trees that escape oak wilt damage in infected stands. We should look also for resistance to a great number of fungi and insects that spoil this tree in the northern part of its range.

ASPENS (*POPULUS TREMULOIDES* AND *P. GRANDIDENTATA*)

In heavily cankered stands seek trees that show resistance to Hypoxylon and Cytospora cankers. Select also any trees that maintain their vigor and are free from heart rot beyond the usual rotation age and trees that have escaped attack by the forest tent caterpillar and the poplar borer in stands where attacks are general. Clones showing good rooting ability and good stem form and trees with fine branches, giving less entry to heart-rot fungi are desirable. If the aspens are to be propagated from seeds, normal fertile trees of both sexes are necessary. Unfortunately, many good staminate trees found in nature do not produce good pollen, so select for that ability also. Search for adaptation to relatively moist sites in quaking aspen and relatively dry, or at least well-drained, sites in bigtooth aspen.

A current Lake States genetics study indicates that in well-stocked stands plus-tree requirements will call for averages during the first 25 years of growth of not more than about 4.5 growth rings per radial inch, or of not less than 2.3 feet (quaking aspen) and 2.6 feet (bigtooth aspen) in annual height growth. [3]

3/ Some of the superior aspens may be triploids--those whose cells contain three sets, rather than the usual two sets, of hereditary units (genes). A guide for the tentative field identification of possible triploids in the forest is available from the Institute of Paper Chemistry, Appleton, Wisconsin.

Quaking aspen of a single clone showing good stem form, Vilas Co., Wisconsin.

Another aspen clone immediately adjacent to above showing uniformly crooked stems. (Both photos courtesy of University of Wisconsin.)

SUPERIOR TREES FOR SPECIAL PURPOSES

Although forest trees often are grown primarily for wood production, they also have special uses which demand characteristics other than those valued in timber production. Among such special uses are windbreaks and shelterbelts, erosion control, Christmas tree production, and wildlife habitat improvement. Trees outstanding for these special purposes should also be sought.

Traits of Value in Windbreak and Shelterbelt Trees

Windbreaks and shelterbelts often are planted in areas too dry for natural tree growth and on prairie soils that may have high alkali content. For this use select trees that exhibit drought resistance, the ability to grow on alkaline soils, broad crowns, dense branching and foliage production, and superior branch retention. Resistance to windthrow and wind breakage also is at a premium. Relatively rapid growth without spindliness is desirable.

Superior Trees for Erosion Control

A combination of fairly quick, dense shoot growth and extensive, quick-spreading root system is desirable in trees used for erosion-control purposes. Look also for the ability to sprout vigorously after injury.

Seeking Better Christmas Trees

For Christmas tree purposes, trees should have dense branching with reasonably stiff branches (stiff enough to hold ornaments). They should be rather densely covered with needles of good, even color, at least average in length, and of good retention after cutting. The trees should have a crown of uniform taper with a width at the base of the usable portion some 35 to 40 percent of total height. Therefore, select trees exhibiting these characteristics. Search also for the so-called double balsam (fir) as a Christmas tree type (see picture on page 21).

Superior Trees for Wildlife Purposes

For wildlife shelter, select trees with dense full crowns. For wildlife food production, seek trees that produce abundant tender shoots that will remain within reach of browsing animals for a long time, and those with regular and abundant mast production (based on ratings for at least 2 or 3 consecutive years).

Trees of Ornamental Value

Ornamental values of trees are of minor interest to most foresters; yet such trees may be of considerable economic value. It would be desirable, therefore, to report trees that have dwarf or unusual shapes, abnormal branching habits, foliage of special color, or other characteristics of possible ornamental value. Dwarf trees may also be useful in a genetics program through providing dwarfing root stocks.

SELECTION OF HIGH-QUALITY STANDS

The selection of superior stands is of first priority in initiating a forest tree improvement program in the Lake States. However, stands are no better than the trees of which they are composed. Hence, first emphasis in this guide has been placed on bases for recognizing superior trees. To a large extent, the superiority of individual trees depends on how they compare with their close neighbors. It is more difficult to apply a similar method to stands. To some extent, their productivity can be judged by comparing them with yield tables. But such matters as form, branching habit, and freedom from injury must be rated largely by personal judgment. Most foresters recognize an unusually good stand when they see it.

Some of the desirable characteristics of individual trees may reflect environment or past treatment more than heredity. Only by progeny tests or "tree shows" can the value of individual trees as a seed source be determined. Therefore, it is of even greater value to locate stands containing high proportions of superior trees. Since most seeds produced in such stands will have both parents of superior character, the progeny are most likely to be good also.

Special efforts should be made to locate superior stands, to have them set aside for seed production, and to use them as sources of seed for reforestation purposes as extensively as possible. Once mature plantations of high quality are available in the region, they may be even more suitable than the natural stands as seed sources for reforestation purposes.

Search diligently for stands better than average <u>for the locality</u>, because they should provide fertile sources for selecting superior and plus trees.

HOW TO REPORT SUPERIOR TREES AND STANDS

Should you find any forest trees or stands in the Lake States that seem to meet the requirements for superior or plus trees discussed in this guide, please report them through your organization to the Lake States Forest Tree Improvement Committee. It is unlikely that anyone will find trees superior in all the traits listed, but any tree that is superior in any of the desirable traits should be reported.

For superior stands, please give the following information: Location, owner, area, species, age, forest type, average height and d.b.h. of dominant trees, basal area per acre, volume per acre, past treatment, and any special features in which they are superior. For individual trees, provide similar but more detailed information (the sample form on the next two pages indicates the kind of information that is wanted).

The location of superior stands and trees is a first step in improving the genetic quality of our forests. You can help in this vital program.

SUPERIOR AND PLUS TREE RECORD

Species ____________________

Local number ____________________ Committee number ____________________
(Plot and tree number, etc.)

Description of selected tree: - of 3 largest trees (same species) within 66 feet

	Selected tree	(1)	(2)	(3)
Total height-ft.				
Clear length-ft.				
Diameter at 4½ feet-in.				
*Bark thickness-bh,-in.				
Cubic volume-cu.-ft.				
Crown width-ft.				
*Age-years				
Branch length (A, average; +, above average; -, below average)				
Branch thickness (A,+,-)				

Other superior traits of selected tree:

*Straightness of grain ____________________ *Specific gravity of wood ____________________

*Percent summerwood ____________________ Angle of branches from horizontal (90°,+,-) ____________________

Pest resistance ____________________
(Damage by insects, diseases, mechanical breakage)

Other traits ____________________

Location: ____________________

Selection made on land of ____________________
P.O. __________ County __________ State __________
Tree or trees on __________ side of __________ (Highway, route, stream) __________
__________ miles __________ of __________ and __________ miles __________ of __________
(Direction) (Direction)
"40" __________ Section __________ Twshp. __________ Range __________ __________ P.M.
Stand composition ____________________

Aspect __________ Situation __________ Slope __________ Soil description __________

* Avoid serious injury to the tree when taking measurements or samples.

The trees involved in this selection are __________ likely to be cut within ________ years.
Reasons ____
Owner is ______________ likely to prove a willing cooperator ____________________________
Notes on situation ____
____
____

Sketch showing trees and their exact location (use serial numbers) with reference to roads, farm residences, legal corners, or landmarks.

Photograph or Sketch
(show form and size in comparison with adjacent trees)

Map of Location

This publication was issued for the Lake States Forest Tree Improvement Committee by the Lake States Forest Experiment Station. The following publications have been issued previously for the Committee:

Proceedings of the Lake States Forest Genetics Conference.
1953. Lake States Forest Expt. Sta. Misc. Rept. 22, 83 pp. (Processed.)

Proceedings of the Second Lake States Forest Tree Improvement Conference.
1955. Lake States Forest Expt. Sta. Misc. Rept. 40, 108 pp., illus. (Processed.)

Forest Genetics in the Lake States, An Annotated Bibliography, by William J. Libby, Burton V. Barnes, and Stephen H. Spurr.
1956. Univ. of Mich. School of Natural Resources (no series), 74 pp. (Processed.)